FINAL REPORT

GROUND-WATER MONITORING FOR VOLATILE ORGANIC COMPOUNDS WITHIN THE GALLATIN LOCAL WATER QUALITY DISTRICT

Prepared

For

Joe Meek
Montana Department of Environmental Quality
Planning, Prevention, & Assistance Division
Metcalf Building
Helena, MT

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Submitted

By

Tammy Crone
Water Quality Specialist
Gallatin Local Water Quality District
1709 W. College St., Suite 104
Bozeman, MT

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TABLE OF CONTENTS

List of Figures

List of Tables

Appendix A

Appendix B

1 Introduction

1.1 Project History

This project was conducted by the Gallatin Local Water Quality District (GLWQD) to screen ground-water monitoring wells for volatile organic compounds (VOC) within the GLWQD. The source of funding for this contract was a federal grant from the U.S. Environmental Protection Agency administered by the Montana Department of Environmental Quality (MDEQ). Contract funding was for a maximum of $10,890.

The GLWQD proposed to sample up to 50 established ground-water monitoring locations in the Gallatin Valley for regulated and unregulated VOCs, record well information and monitoring results for each site, establish a schedule for repeated sampling of wells based on screening results, and provide the data to the Montana Bureau of Mines and Geology's Ground-water Information Center (GWIC) and MDEQ Source Water Protection Program.

Work began on the project in November 2009, with a scheduled completion date of December 31, 2009. Due to GLWQD inclement weather and equipment problems the contract period was extended until January 31, 2010.

1.2 Project Location

This project was completed within the boundary of the GLWQD. The wells sampled are shown in Figure 1. Three wells sampled were outside the District boundary and are part of the Montana Bureau of Mines and Geology (MBMG) state-wide ground-water monitoring network. These wells are monitored regularly by GLWQD for static-water levels as part of an MOU with MBMG.

1.3 Project Purpose

The purpose of this project was to screen up to 50 domestic and dedicated monitoring wells for VOCs in the Gallatin Valley as identified in the GLWQD Long-Term Ground-Water Monitoring Plan. This plan was approved by the GLWQD Board of Directors in March 2008. The wells sampled are part of the GLWQD Ground-Water Monitoring Network. This network contains dedicated monitoring wells established by the GLWQD and a selection of dedicated monitoring and domestic wells as part of the MBMG state-wide ground-water monitoring network.

This project also supported several activities identified in the GLWQD Five-Year Strategic Plan for 2010-2014. These activities include: (a) Assisting MDEQ with updating their public water supply database, (b) offer information and assistance to public water supply operators in the District, (c) provide source water protection information to public water supplies in the District, (d) conduct water-quality sampling of ground water in the District, and (e) provide ground-water data to the MBMG GWIC database.

Additionally, this project supported several components of the Ground-Water Section of the Montana Water Plan. These include: (a) Subsection A, Issue 2 - MDEQ and Local Water Quality Districts encourage inventory and monitoring of contaminant sources, and (b) Subsection C, Issue 7 Recommended Option 7 – Inventory potential contaminant sources where public water supplies are using ground water.

This completed project will also assist MDEQ in meeting several Water Quality Pollution Prevention Strategic Objectives and Template Measurements in their Performance Partnership Agreement with the Environmental Protection Agency (EPA) under the Source Water Protection Program.

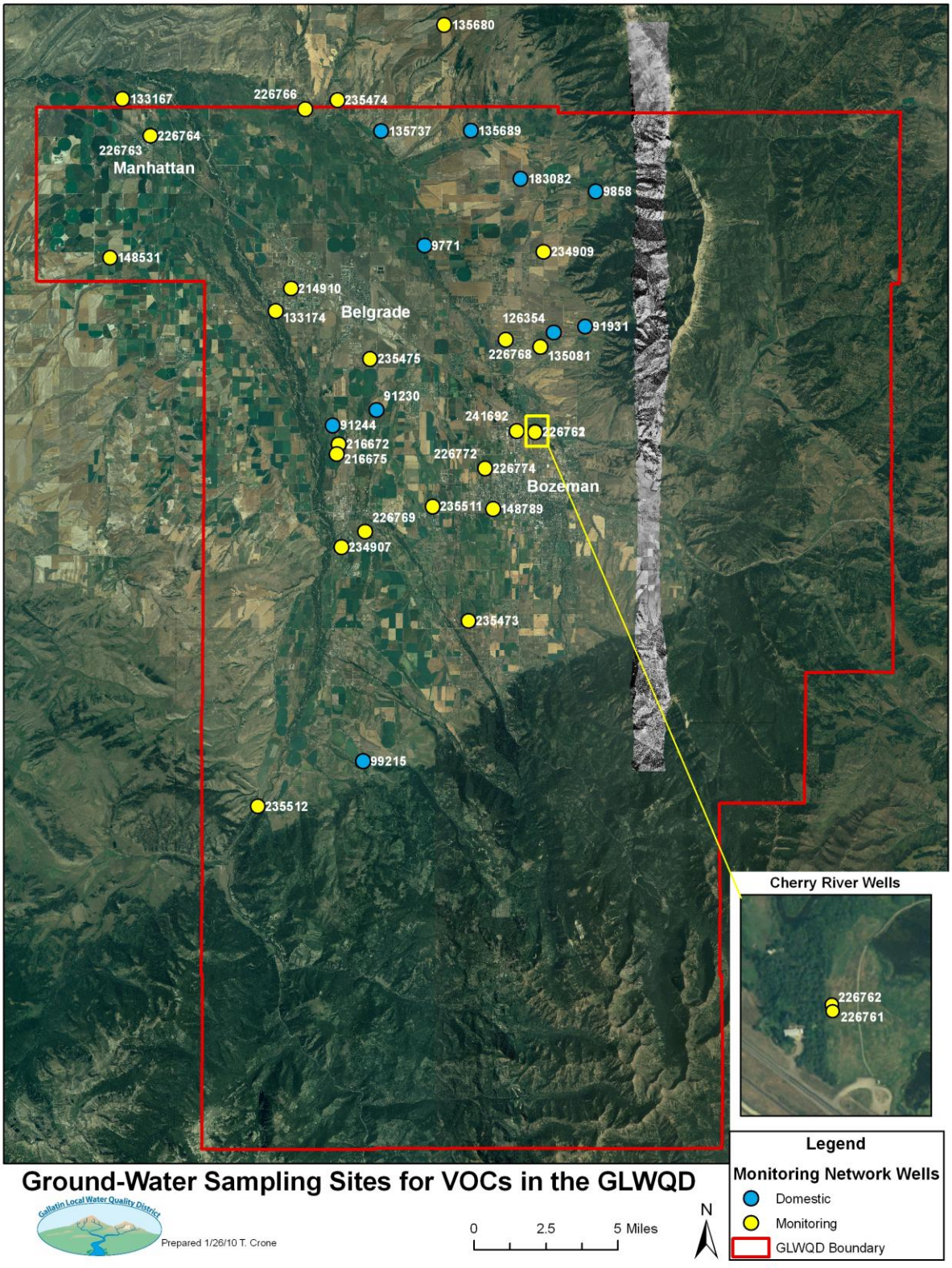

Figure 1. VOC sampling sites within the GLWQD ground-water monitoring network.

2 Project Overview

2.1 Project Goals and Objectives

The goals and objectives for this project were:

GOAL 1. Identify areas in the Gallatin Valley where ground water may be contaminated with VOCs.

- *Objective 1: Collect ground-water samples from existing monitoring locations in the GLWQD for VOC analysis at a state-certified testing laboratory.*

GOAL 2. Make monitoring data available for public access.

- *Objective1: Provide field data and laboratory results to MBMG GWIC.*
- *Objective 2: Provide field data and laboratory results to MDEQ.*

The goals of this project have been achieved with the completion of sampling 36 wells for VOCs (plus 7 QA/QC), and making the monitoring data available for public access both through the MBMG GWIC and via MDEQ. Additionally, the data is also available to the public through the GLWQD office. A Quality Assurance Project Plan (QAPP) and Standard Operating Procedures (SOP) for VOC Sampling of Ground-Water were developed for this project as well.

2.2 Milestones

The GLWQD proposed to sample up to 50 wells in the District for VOCs. Table 1 lists the project milestones and completion.

Table 1. GLWQD VOC 2009 Project Milestones

Well Type	# of Wells Proposed to Sample	# of Wells Sampled
GLWQD Monitoring Wells	23	22
MBMG Domestic Wells	10	10
MBMB Monitoring Wells	17	4
QA/QC Samples	5	7
Total Wells (incl. QA/QC):	**55**	**43**

This was the first attempt to sample the GLWQD Monitoring Network for VOCs. The variety of well types provided a challenge for GLWQD staff in establishing preferred sampling methods while maintaining the integrity needed for VOC sampling. Because of the problems associated with the majority of the MBMG monitoring wells, the GLWQD may begin to evaluate and identify locations for placement of additional GLWQD monitoring wells in the vicinity of these MBMG wells so that future sampling can be successfully completed.

One GLWQD monitoring well could not be sampled because it was dry. Numerous difficulties were encountered when attempting to collect samples from the MBMG monitoring wells. Two of these wells were completed with 1.2-inch PVC casing. The GLWQD sampling pump has a 2-inch diameter. One well had a static water level greater than 100 feet and the GLWQD pump and tubing was only 90 feet long. The remainder of the MBMG monitoring wells had extremely long purging times due to a combination of either 6-inch or 8-inch casing diameters and large volumes of water in the casing. Because the GLWQD sampling pump has a capacity for pumping at about 2 gallons/minute, it was time-prohibitive to collect samples from these wells.

The number of QA/QC samples collected was increased to check the integrity of the sampling equipment and resample a well which had a positive VOC result. This is discussed in Section 3.

3 Results

Site names and corresponding GWIC IDs are listed in Appendix A. Samples were analyzed for a suite of 85 purgeable organic compounds by Energy Laboratory in Billings, Montana (Appendix B). Table 2 lists the wells with detected levels of VOCs and the associated primary drinking water MCL for each parameter. QA/QC results are not included in this table and are discussed separately in Section 3.2.

3.1 Monitoring and Domestic Wells

Of the 36 wells sampled, 5 wells had detects for VOCs. The 2 VOCs detected were chloroform and tetrachloroethene. Chloroform is one of the regulated trihalomethanes. Tetrachloroethene was detected below the MCL of 5 ug/L. VOC results for all 10 domestic wells sampled were negative.

Table 2. Wells Sampled with Detected Levels of VOCs using EPA Method 524.2

GWIC ID	Sample ID	Collection Date	VOC (µg/L)		
			Chloroform *(MT MCL = 70)*	Trihalomethanes, Total *(EPA MCL = 80)*	Tetrachloroethene *(EPA MCL = 5)*
241692	241692-VisCtrA	12/16/09	**1.0**	**1.0**	**0.85**
226774	22674-RegParkS	12/21/09	**0.46 (J)**	**0.46 (J)**	ND
226772	226772-RegParkD	12/21/09	**1.4**	**1.4**	ND
226762	226762-CherryRSA	01/05/10	ND	ND	**1.3**
226761	226761-CherryRD	01/05/10	ND	ND	**0.66**

(J) = Estimated value. Compound present but at less than the Reporting Limit of 0.50 µg/L.

3.2 Quality Assurance/Quality Control

Duplicate samples were collected from one domestic well (91244) and two GLWQD monitoring wells (241692 and 226762). These wells were selected based on the probability they could be susceptible to VOC contamination based on the domestic well landowner's concern for potential contaminant sources in the area and location of the two monitoring wells in a controlled ground-water area for tetrachloroethene. QA/QC results are in Table 3. All trip blanks were negative.

Table 3. QA/QC Results for VOCs using EPA Method 524.2

GWIC ID	Sample ID	Sample Type	Collection Date	VOC (µg/L)		
				Chloroform *(MT MCL = 70)*	Trihalomethanes, Total *(EPA MCL = 80)*	Tetrachloroethene *(EPA MCL = 5)*
91244	91244B-Sievert	Duplicate	11/10/09	ND	ND	ND
n/a	121609B Peri	Equip Blank	12/16/09	**1.3**	**1.3**	ND
241692	241692-VisCtrB	Duplicate	12/16/09	**1.0**	**1.0**	**0.94**
n/a	121809B Proact	Equip Blank	12/18/09	**17**	**17**	ND
n/a	010510 ProactB	Equip Blank	01/05/10	**20**	**20**	ND
226762	226762-CherryRSB	Duplicate	01/05/10	ND	ND	**1.2**
226772	226772-RegParkD2	Repeat	01/14/10	**1.6**	**1.6**	ND

Tetrachloroethene was detected in duplicate samples collected from wells 241692 and 226762 at 0.94 µg/L and 1.2 µg/L, respectively. Results for the original samples were 0.85 µg/L and 1.3 µg/L, respectively, indicating tetrachloroethene is present in ground water at these sites.

Chloroform, a component of total trihalomethanes, was detected in 5 of the 7 QA/QC samples. Of those 5 samples, 3 were equipment blanks. Chloroform was also detected in 2 monitoring wells (241692 and 226772). The QA/QC duplicate result from well 241692 was identical to the original sample. After the initial detection of chloroform in well 226772 on 12/21/09, staff returned to collect another sample on 1/14/10, to see if the result could be repeated. A hit was detected at 1.6 µg/L.

4 Discussion

The results of this screening project reveal, overall, that VOCs are not impacting ground-water quality in the GLWQD. However, three sites north of Bozeman warrant continued monitoring because of VOC detection. Figure 2 illustrates the location of the chloroform and tetrachloroethene detects.

Two of the three wells hypothesized to test positive for VOCs, as discussed previously in Section 3.2, were found to have detectable levels of tetrachloroethene. These wells (241692 and 226762) are both completed in shallow ground-water and both are down-gradient of the Bozeman Solvent Site (BSS). The BSS is an area of known tetrachloroethene-contaminated ground water in the City of Bozeman. It is a State Superfund Site with a Controlled Groundwater Area that extends north from the Hastings Shopping Center along Main Street to the East Gallatin River (Figure 2). Well 226761 is the deeper monitoring well next to 226762 and the detection of tetrachloroethene, while not expected here, was not surprising.

The high frequency of chloroform detected in the equipment blanks was unexpected. Chloroform is a disinfection byproduct associated with the chlorination process of municipal drinking water. It is also associated with the chlorination of water for swimming pools, spa water and municipal wastewater. Chloroform is also a common laboratory contaminant associated with VOC sample analysis.

Laboratory contamination can be ruled-out as a source of the chloroform since detections were not wide-spread and sporadic throughout the samples. Rather, the number of detects was limited to the equipment blanks and three wells which are located in the Bozeman area serviced by municipal water.

Chlorination is the only treatment process utilized by the City of Bozeman for the municipal water supply. The Bozeman Water Treatment Plant was contacted to determine what the range of chloroform levels are in the water. The range of chloroform for 2008-2009 was 11-34 µg/L, with an average of 20 µg/L (J. Miller; personal comm.. 1/28/10). The levels of chloroform detected in two of the equipment blanks for this project were 17 µg/L and 20 µg/L.

Because of the confirmed levels of chloroform that are found in the Bozeman municipal water supply, we believe the deionized water used in the equipment decontamination process for this project is the source of the chloroform in the equipment blank samples.

During the decontamination process, a deionized water rinse was performed prior to a final HPLC-grade deionized water rinse. Our goal for the equipment blanks was to capture the HPLC-grade deionized water at the end of the decontamination procedure for laboratory analysis. However, based on the detection level of chloroform in the equipment blanks, it is more likely that the regular deionized water was collected and analyzed. This deionized water was obtained from Montana State University Water Quality Extension (MSUWQE). Montana State University is serviced by the Bozeman Water Treatment Plant. In Leon Johnson Hall, where MSUWQE is located, water is run through a filtration process and then distributed via dedicated deionized water taps to various laboratories in the building. If time had permitted, it would have been beneficial to submit deionized water blanks for analysis to confirm this was the source of the chloroform.

Chloroform was detected in duplicate in well 226772 and upon repeat sampling of well 241692. These results are valid. Residual deionized water remaining in the equipment tubing can be ruled-out as the source of the chloroform in these samples, since the wells were purged of three well volumes prior to sample collection. Because the wells with chloroform detects are located within the service area of the Bozeman municipal water supply, and since chloroform breaks down slowly in water, the source of chloroform could be leaking water mains resulting in treated municipal water infiltrating ground water.

As per the requirements of the GLWQD Long-term Ground-Water Monitoring Plan, wells 241699, 226761, 226762, 226772 and 226774 will be evaluated for more frequent VOC monitoring which is anticipated to be on an annual basis.

5 Project Completion

This project to screen wells in the Gallatin Valley as part of the GLWQD Monitoring Network is completed. All laboratory results for the 43 samples have been completed and submitted to MDEQ in pdf format (GLWQD VOC2009_pdfLab) and MS Excel Worksheet format (GLWQD VOC2009_Lab). Field data has also been provided in an MS Excel worksheet (GLWQD VOC2009_Field). These same MS Excel documents have been sent to GWIC for input into the state-wide database.

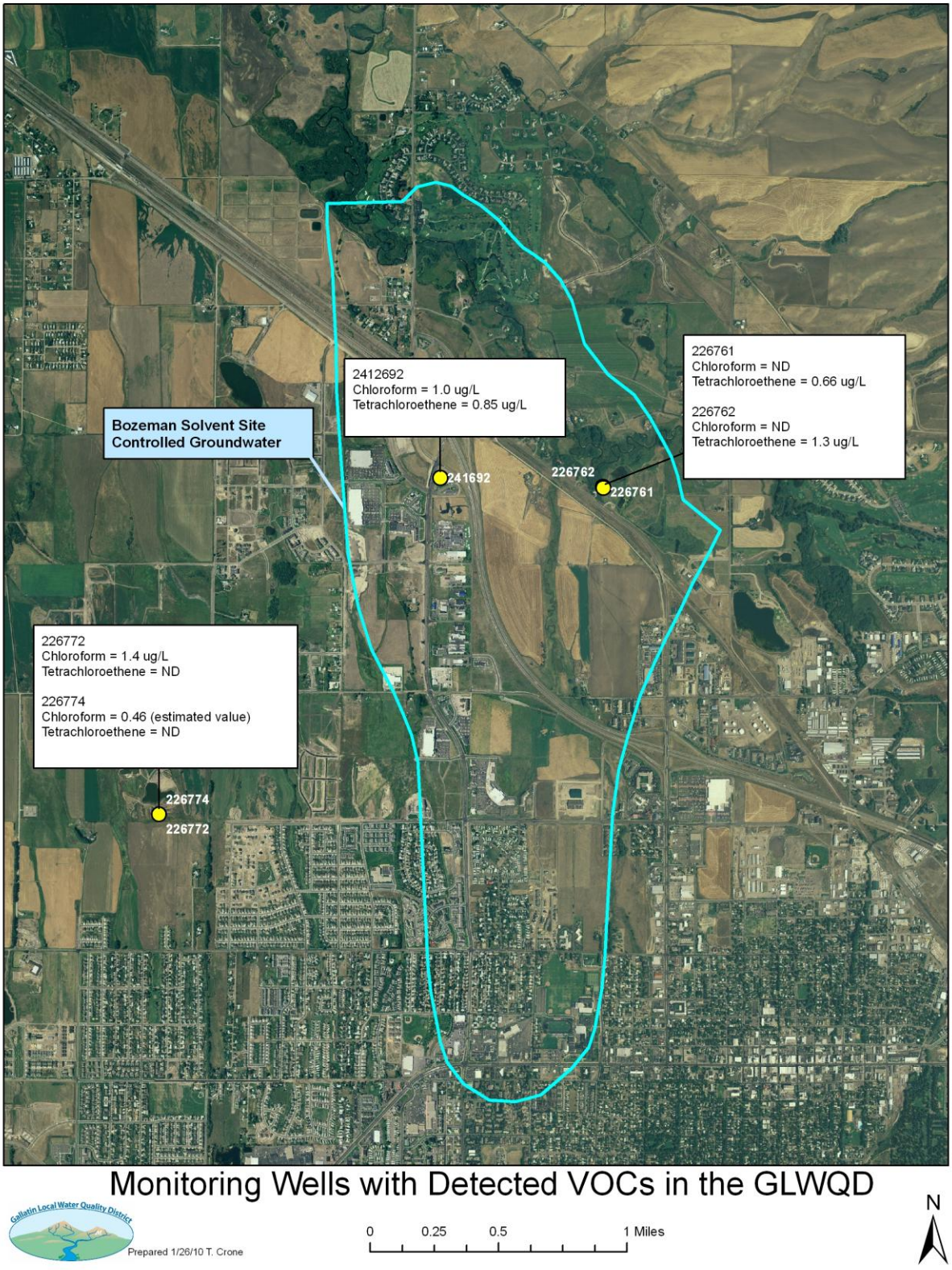

Figure 2. Locations of VOC detections in ground water in the GLWQD.

APPENDIX A
Sample Site Names & GWIC ID

GWIC ID	Well/Site Name	Type
226763	Altenbrand – Deep	GLWQD Monitoring
226764	Altenbrand – Shallow	GLWQD Monitoring
148789	Bozeman Pond	GLWQD Monitoring
226762	Cherry River – Shallow	GLWQD Monitoring
226761	Cherry River – Deep	GLWQD Monitoring
226769	Cimarron	GLWQD Monitoring
214910	Cobblestone #5	GLWQD Monitoring
226766	Dry Creek School	GLWQD Monitoring
234907	Faust	GLWQD Monitoring
235512	Flying D Ranch	GLWQD Monitoring
216672	County Gravel Pit – North	GLWQD Monitoring
216675	County Gravel Pit – South	GLWQD Monitoring
235473	Haggarty	GLWQD Monitoring
235511	Lien	GLWQD Monitoring
234909	Lutz Farm	GLWQD Monitoring
241692	MDOT N. 19th Visitor Center	GLWQD Monitoring
235474	Mockingbird	GLWQD Monitoring
226774	County Regional Park – Shallow	GLWQD Monitoring
226772	County Regional Park – Deep	GLWQD Monitoring
135081	Summer Ridge Subdivision	GLWQD Monitoring
226768	Wheatland Hills Subdivision	GLWQD Monitoring
235475	Yukon Subdivision	GLWQD Monitoring
183082	Brown	MBMG Domestic
9858	Harjes	MBMG Domestic
99215	Huttinga	MBMG Domestic
91230	Marx	MBMG Domestic
91931	Russoff	MBMG Domestic
135737	Scoggins	MBMG Domestic
91244	Sievert	MBMG Domestic
126354	Stathatos	MBMG Domestic
9771	Thompson	MBMG Domestic
133174	Torgerson	MBMG Domestic
135689	Cook Ranch	MBMG Monitoring
133167	FDD Ranch-King	MBMG Monitoring
148531	Schutter	MBMG Monitoring
135680	Stover	MBMG Monitoring
n/a	Peristaltic pump equipment blank	QA/QC
91244	Sievert duplicate	QA/QC
n/a	Proactive pump equipment blank	QA/QC
226762	Cherry River Shallow duplicate	QA/QC
241692	MDOT N. 19th Visitor Center duplicate	QA/QC
n/a	Proactive pump equipment blank #2	QA/QC
226772	County Regional Park – Deep (repeat)	QA/QC

APPENDIX B
VOC Analyte List

Purgeable Organics, Safe Drinking Water Act Regulated and Unregulated VOC Analyte List (Method E524.2) for Energy Laboratories, Inc., Billings, Montana.

Regulated VOCs	
Benzene	Styrene
Carbon Tetrachloride	Tetrachloroethene
Chlorobenzene	Toluene
1,2-Dichlorobenzene	1,2,4-Trichlorobenzene
1,4-Dichlorobenzene	1,1,1-Trichloroethane
1,2-Dichloroethane	1,1,2-Trichloroethane
1,1-Dichloroethene	Trichloroethene
cis-1,2-Dichloroethene	Vinyl Chloride
trans-1,2-Dichloroethene	Xylenes:
1,2-Dichloropropane	M
Ethylbenzene	P
Methylene Chloride	O
Total Trihalomethanes	
Bromodichloromethane	Chlorodibromomethane
Bromoform	Chloroform
Other EPA Listed VOCs	
Acetone	2,2-Dichloropropane
Acrylonitrile	Diethyl ether
Allyl chloride	Ethyl methacrylate
Bromobenzene	Fluorotrichloromethane
Bromochloromethane	Hexachlorobutadiene
Bromomethane	Hexachloroethane
2-Butanone	2-Hexanone
n-Butylbenzene	Isopropylbenzene
sec-Butylbenzene	p-Isopropyltoluene
tert-Butylbenzene	Methacrylonitrile
Carbon disulfide	Methylacrylate
Chloroacetonitrile	Methyliodide (Iodomethane)
1-Chlorobutane	Methylmethacrylate
Chloroethane	4-Methyl-2-pentanone
Chloromethane	Methyl-t-butyl ether
2-Chlorotoluene	Naphthalene
4-Chlorotoluene	Nitrobenzene
1,2-Dibromo-3-chloropropane (DBCP)	2-Nitropropane
1,2-Dibromoethane (EDB)	Pentachloroethane
Dibromomethane	Propionitrile
1,3-Dichlorobenzene	n-Propylbenzene
Trans- 1,4-Dichloro-2-butene	1,1,1,2-Tetrachloroethane
Dichlorodifluoromethane	1,1,2,2-Trichlorobenzene
1,1-Dichloroethane	Tetrahydrofuran
1,1-Dichloropropanone	1,2,3-Trichlorobenzene
1,1-Dichloropropene	1,2,3-Trichloropropane
1,3-Dichloropropane	1,2,4-Trimethylbenzene
cis-1,3-Dichloropropene	1,3,5-Trimethylbenzene
trans-1,3-Dichloropropene	